The 1980s

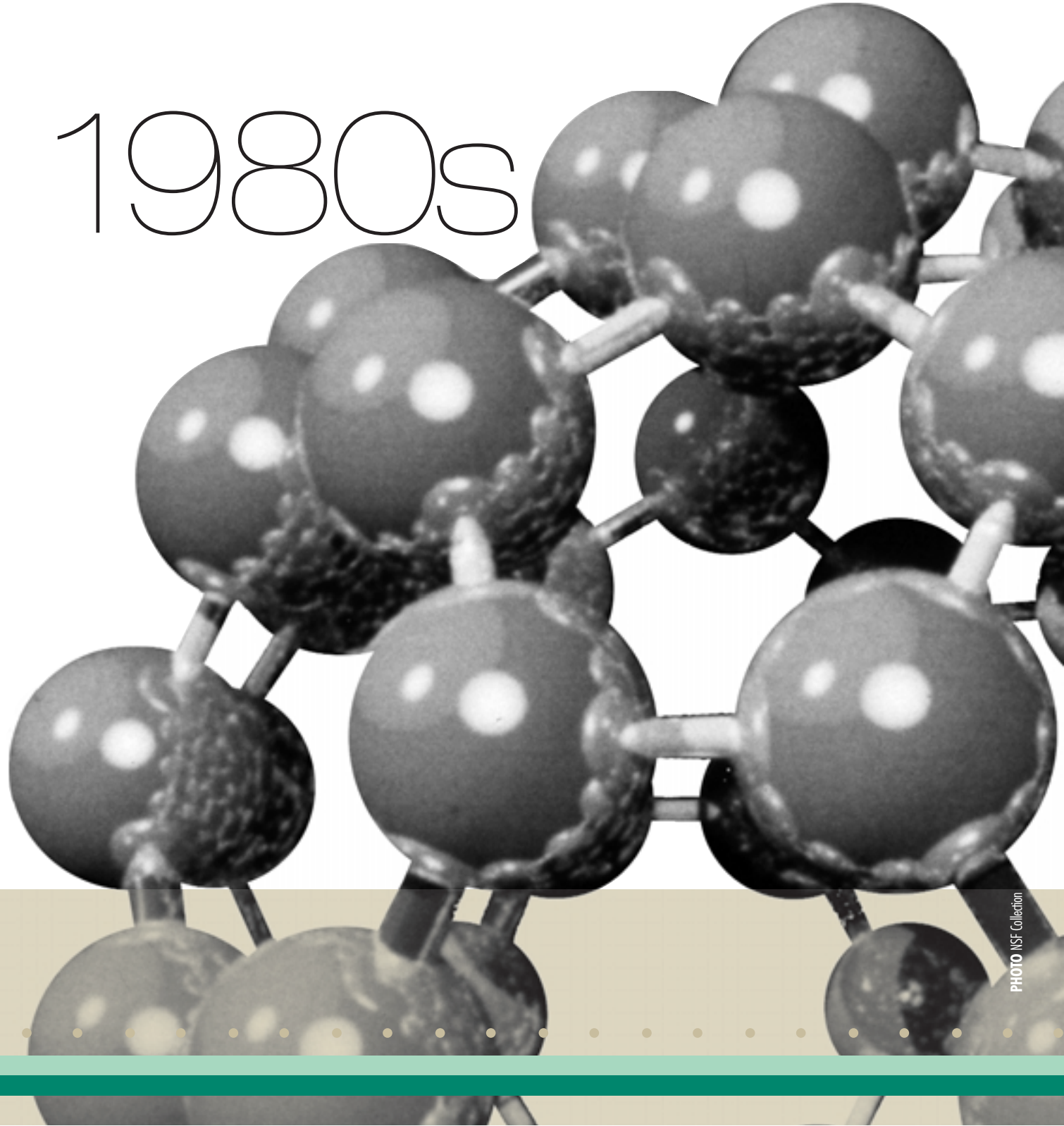


PHOTO NSF Collection

RETHINKING AND REBUILDING

When Ronald W. Reagan was elected President in November 1980, Iranians held American hostages, oil-exporting Nations were raising prices, Japan seemed on track to become the world's economic powerhouse, and recession and high unemployment all rocked American confidence. Though hard to detect at the time, the stage was being set for a renewal of U.S. research. Companies began more university-based research partnerships, with biotechnology an early result. States invested more in local universities and colleges to attract high-tech industry and skilled workers. Whereas researchers on the East and West coasts had traditionally received most basic research funds, now researchers in many parts of the country competed for—and won—prestigious awards.

Though the Foundation reeled from budget cuts in the early Reagan years, the Administration's idea of rethinking government took hold. The Foundation evolved as a result of an innovative Director and strong Board leaders. By FY1990, when its budget had risen from $1 billion to $2 billion, NSF was a remodeled institution whose budget better served its core mission.

Engineering Gets a Promotion

By 1980, one of the Foundation's best friends in the House, Congressman George E. Brown (D-CA), chair of the Committee on Science and Technology, was criticizing NSF for not doing more to make U.S. technology more globally competitive. Brown (supported by engineers who, according to historian Belanger, felt "in the position of a neglected child"), pushed to set up a separate National Technology Foundation. The move forced NSF leaders to defend engineering's rather low status at the agency. NSF's long resistance to sponsoring engineering research stemmed from a belief that engineering was applied work, not basic scientific research. But a separate foundation did not seem desirable, either.

The Foundation's management was in flux at this time. The new Director–designate, electrical engineer John Slaughter, would not take office until December and the Acting Director was a university physicist, Donald N. Langenberg. The Board was in a better position to respond to Brown, given that it included more members than usual from industry. Board Chair Lewis M. Branscomb was a physicist and chief scientist at IBM. Vice Chair Herbert Doan worked at Dow Chemical. Another member, Joseph M. Pettit, president of Georgia Tech, chaired a Board group to study the oft-repeated charge that engineering research was, at best, "just" applied science.

"[D]edication, objectivity, and excellent research credentials on the part of each and every Board member are indispensable to the effectiveness of the Foundation. They constitute its protection from forces that, unopposed, would reduce NSF to just another federal agency."

Lewis Branscomb, Board Chair (1980-1984)

1980 Reagan elected President

1981 Initial stock offering by Genentech signals era of biotechnology

1982 First measurement system of El Niño/La Niña in Pacific Ocean

1980 1981 1982

NSB Chair Branscomb

NSF Director Slaughter | NSF Director Knapp

Drawing on the Pettit group, Branscomb argued that engineering research was neither basic scientific research nor applied science. Still, it was worthy of NSF support because when engineering research activities "stay ahead of state of the art they necessarily push up against the scientific frontier." University science and engineering had "an intimate relationship, each supporting each other." Therefore NSF, not some new foundation, should support basic engineering research.

The Board invited the National Academy of Engineering (NAE) to weigh in. The NAE endorsed a directorate in NSF rather than a new institution, and a new Engineering Directorate came into being in March 1981. To emphasize that it was now "not conceptually correct" to consider engineering an applied field, the Board determined that NSF's existing applied programs should be relocated to their respective disciplinary directorates rather than housed in engineering. The new directorate would foster innovations that helped to revive U.S. industry.

Peer Review Broadened

The advent of the Engineering Directorate prompted a rethinking of the Foundation's peer review process. Reviewers at the time used two main criteria: the intrinsic scientific merit of the proposal, and the qualifications and competence of the principal investigator. But now applied research projects were to be dispersed into other directorates, with the understanding that the distinction between "basic" and "applied" research should not be rigid. So in 1981, the Board oversaw a broadening of the criteria to include an additional two: the utility or relevance of the research, and the effect of the research on the infrastructure of science and engineering, including better public understanding and contributions to the Nation's education and workforce base. To signal the broader basis for judgment, the term "peer review" was changed in 1986 to "merit review" on Director Erich Bloch's recommendation. The Board also provided guidance on the emphasis to be given these criteria in various parts of the Foundation.

While other modifications have come under the Board's consideration since 1981, the spirit of these four criteria remains in effect today. In March 1997 the Board approved the restructuring of merit review to two mandatory criteria so that appropriate attention was given to integration of research and education and contributions to national goals.

K-12 and Undergraduate Education

In 1981, Foundation leaders learned that the Reagan Administration would cut all funding to the agency's education programs, except fellowships for advanced students. The social sciences were also curtailed in the raft of federal programs that had to shrink to accommodate Reagan's tax cuts and huge defense build-up. The Reagan

1984 *A Nation At Risk* sparks debate on K-12 education

1984 Apple introduces the mouse and the pull-down menu

1984

NSB Chair Schmitt
NSF Director Bloch

team singled out education, however, arguing it must be left to state and local governments. When the axe fell there was no appeal.

The Directorate of Education was abolished in April 1982. Later that year, Director Slaughter, the Foundation's first African American director, left the post; he had accepted the appointment from President Carter in hopes of a very different climate. Slaughter's successor was Edward A. Knapp, a physicist from Los Alamos National Laboratory, who had better ties to George A. Keyworth II, the President's Science Advisor.

Despite the chilly climate, the Board decided that it would initiate a national policy report on ways to improve the sorry state of U.S. science and mathematics education. Members took strength from a paper by Philip M. Smith, who had served previous NSF directors and in the President's Office of Science and Technology Policy, urging the Board to exercise more of its national policy role than it had in the past. In June 1982, the Board resolved that the Foundation should play "a leadership role with respect to…other elements of the science and engineering enterprise, for example: evaluation of the health and achievements of the entire enterprise, and its human resource problems and needs."

Toward this end, the Board appointed a rare outside commission, co-chaired by William Coleman, Transportation Secretary in the Ford Administration, and Cecily Canaan Selby of the North Carolina School of Science and Mathematics. The commission's two-volume report, *Educating Americans for the 21st Century*, built a strong case for science education and for the federal government's role within it. Published in 1983, the Coleman-Selby report received less public acclaim than another report that year, *A Nation at Risk*, which stoked public outrage over low U.S. educational achievement. But the Coleman-Selby report was aimed at educators and policymakers and helped to spark teaching reform and the evolution of national standards. The report also signaled the revival of NSF's education program. By 1990, NSF's education budget would pass $300 million.

During the mid-1980s, the Board addressed another deficiency in U.S. education: undergraduate courses in science, mathematics, and engineering. The Foundation had done much over the years to support students with clear promise of scientific careers. But what about undergraduates who were not headed for Ph.D.s? A Board panel headed by Homer A. Neal, a physicist then at SUNY-Stony Brook, urged the Foundation to "bring its programming in the undergraduate education area into balance with its activities in the precollege and graduate areas as quickly as possible." Pedagogically, the panel recommended that improved undergraduate science, mathematics and engineering courses combine "hands on" research experience with formal instruction. In addition, the Foundation should also launch efforts "to improve public understanding of science and technology."

"The Foundation must concern itself with the overall excellence of the scientific and engineering knowledge base and human resources for the long-range needs of the Nation."

1982 NSB Resolution

1985 Curl, Kroto, and Smalley discover a new form of carbon, the fullerene or "buckyball" (Nobel 1996)

1985

NSB Chair Schmitt
NSF Director Bloch

The Board adopted the Neal panel's report in March 1986. New undergraduate efforts helped move education at NSF into high gear. But they achieved more. Later testimonials counted NSF-funded improvements in the teaching of calculus as one of the most significant products ever to come out of NSF.

New Director Stresses Diversity

Education and workforce issues were high priorities for the two men who took the agency's top jobs in 1984. In May, physicist Roland W. Schmitt, a two-year member of the Board and senior vice president for research and development at General Electric Company, was elected Board Chair. Following the sudden departure of Director Edward Knapp, President Reagan promoted Erich Bloch from Deputy Director-designate to the Director's post. Bloch was a hard-driving IBM engineer who had managed the development and manufacture of the IBM System 360 computer technology.

All of a sudden, the Foundation had acquired a pair of leaders from industry. Bloch and Schmitt got along well and thought similarly about changes needed at NSF. Homer A. Neal, whose Board panel was devising the Foundation's undergraduate initiatives at this time, describes Bloch's results-oriented style this way: "Bloch would sit in our meetings. Sometimes he would pick up on something and carry it out before we had finished."

Part of Bloch's agenda was to help more people in underrepresented groups—minorities, women, and persons with disabilities—join America's scientific and technical workforce, including those doing advanced research. This meant increasing the numbers of these individuals who completed a K-12 mathematics/science curriculum.

Such an ambitious goal required enormous change for the Foundation, including the identification and recruitment of qualified professionals from these groups to NSF staff positions and to advisory and merit review panels. Overseeing this effort for the Board from 1984 to 1986 was Simon Ramo, co-founder of aerospace giant TRW, Inc. Ramo agreed to head the Board's Education and Human Resources (EHR) Committee because, he told Schmitt, "that's the future." Minutes of Ramo's EHR Committee meetings show that managers from all parts of NSF were systematically called on to explain exactly what steps they were taking to satisfy the new diversity mandate.

Bloch argued that diversifying the technical workforce was particularly urgent in light of limited numbers of qualified Americans to fill available jobs. The Office of Technology Assessment would later sharply criticize the data behind the "shortfall" argument, but Walter Massey, a Board member in the 1980s and the Foundation's second African American director, credits Bloch and the Board with opening the door to wider participation by underrepresented groups. The diversity campaign gained clout when programs such as EPSCoR were consolidated with programs for minorities in the renamed Education and Human Resources Directorate.

1986 Bednorz and Müller discover high-temperature superconductivity (Nobel 1987)

1986 Space Shuttle Challenger explodes

1986 Halley's comet returns

1986

NSB Chair Schmitt
NSF Director Bloch

The Debate Over Centers

Doubling the Foundation's size was among the options discussed at the Board's first long-range planning meeting with Bloch, in June 1985. Schmitt recalls, "Erich came in with the view that the Foundation had to become a central player in the Nation." Two years later, Bloch strategically chose not to attend a meeting between the Board, members of industry (including David Packard, founder of Hewlett Packard Co., and John Young, the company's chairman), and the White House at which Schmitt argued for doubling NSF's budget to $3.2 billion within five years. That active leaders of industry, and not just Bloch, wanted the Foundation to move to center stage on R&D was evidently not lost on the Reagan officials. They agreed to the plan.

But even a larger Foundation could not fund all the work that was needed. As Bloch said, "Science and engineering are just entering a long period of accelerating progress. We have never seen anything like it." A Board committee under Annelise Anderson of the Hoover Institution studied ways the Foundation could leverage federal funds so that industry, states, and other interested parties would invest in long-term basic science and engineering research—the kind of R&D that many companies found too costly and risky to conduct on their own.

An NSF initiative launched by Bloch, and encouraged by a National Academy of Engineering committee chaired by Dale Compton, made Engineering Research Centers (ERCs) the Foundation's major new initiative for leveraging NSF funds. ERCs operate as stand-alone entities on campus with long-term NSF funding matched by industry and state funds. Multidisciplinary teams conduct basic research and educate students in a real-world context, changing focus and approaches as needed to address emerging scientific issues. The first six ERC contracts were awarded in FY1985. At the same time, NSF awarded five five-year contracts for supercomputing centers modeled along similar lines. Based on these experiences Bloch also wanted NSF to sponsor a large number of Science and Technology Centers (STCs) on campuses across the country. This plan was encouraged by a National Academy of Sciences study chaired by Richard N. Zare. The first eleven STCs were selected in 1988 and funded for $25 million, ranging in focus from storm prediction to cosmology.

Some Board members questioned whether centers would take funds away from individual investigators. As a result, centers have firm time limits and cannot be renewed without recompetition.

The Ozone Hole

The Board met in March 1987 amidst global anxiety about a growing hole in the protective layer of ozone over Antarctica. A debate raged as to whether chlorofluorocarbons (CFCs), used in coolants, insulators, and sprays, were at fault. Board Chair Roland Schmitt pushed NSF to investigate the problem. The world was watching. "We were working in a goldfish bowl," says Susan Solomon of the National Oceanic and Atmospheric Administration.

Subsequently, first-time measurements taken at Palmer Station, an NSF-supported Antarctic research base, ruled out natural causes as the culprit. By the fall of 1987, international efforts were underway to limit CFC production. Solomon says that the Board's interest "helped to create the will in the logistics side of the [Foundation] to deal with the challenge and to do a more complete job."

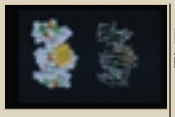
Board member Mary Good, senior vice president of Allied Signal Corporation and eventual Board Chair in 1988, regarded the Board's status as the Foundation's legally responsible authority—and not mere advisors—as instrumental in shaping Bloch's plans for the greatest chance of success. "Erich learned a lot about how universities work from the Board," says Good, and so was better able to build his agenda around the needs of the academic community. If the Board had been only advisory, says Good, the fast-moving Bloch might not have taken this vital NSF constituency into sufficient consideration.

Controversial Projects

The Board acted as a buffer against outsiders who questioned controversial projects, thus freeing the Director to push harder at the frontiers. For example, a small group on Bloch's staff wanted NSF to take over the communications network that connected computers run by the Defense Advanced Research Projects Agency, or DARPA. Their plan was to fuse NSF's young network, known as CSNet, with the ARPANet backbone to create a larger network—NSFNet. In 1987, the Board approved the Foundation's proposal to award the administration of NSFNet to Merit Inc., an unusual consortium consisting of the University of Michigan and two private companies, MCI and IBM. The risk paid off handsomely. NSFNet grew into the Internet, an enterprise largely funded by the private sector and the cornerstone of a revolutionary new economy.

Another controversial decision marked an August 1986 Board vote to award $25 million for a new Earthquake Engineering Center at the State University of New York at Buffalo. Charles E. Hess, Vice Chair and a long-time Board member from the University of California at Davis, recalls that minutes after the award was announced, the office of Senator Pete Wilson (D-CA) telephoned to ask why the award had not gone to his home state, which had *always* done earthquake research. And who'd ever heard of earthquakes in Buffalo? Hess explained to the Senator that the Board had been just as surprised when the Foundation staff recommended Buffalo, but the Board had made its own review and concurred. Though Wilson mounted an investigation by the General Accounting Office, that office upheld the decision.

As the Foundation's stature and budget grew, more of its awards came to be coveted for their economic potential as well as opportunities for discovery. Other contentious decisions were the Board's 1990 award to build the National High Magnetic Field Laboratory at Florida State University rather than at MIT, where such work had been conducted for years, and the Board's approval in 1994 of the Laser Interferometer Gravitational Observatory (LIGO) project to detect gravity waves. Mary Good, who was Board Chair from 1988 to 1991, believes that if the Board had been merely advisory, a lone Director and staff might not have withstood the pressures. The Board, she says, "being a legally independent agency, had the power and ability to do what they thought was...right...and to stand their ground."



1988 Determination that DNA from a single hair can identify an individual

Revisiting the Poles

In the latter part of the decade, the Board turned its attentions to another area of long-time scientific significance: the North and South polar regions. Since the International Geophysical Year programs of 1957-1958, NSF had been the lead federal agency in the Antarctic. But the budget strains of the 1970s had rendered U.S. stations and other infrastructure there in need of updating. A group of new international agreements in the 1980s further altered U.S. responsibilities in the Antarctic. In the Arctic regions, NSF was one of several agencies conducting research; then in 1984, the Arctic Research and Policy Act gave the Foundation the lead role in the Arctic as well.

For all these reasons, the Board decided to take stock of long-term needs in both polar regions. A Board Committee on the NSF Role in Polar Regions, headed by University of Maryland microbiologist Rita R. Colwell (who would become NSF Director in 1998), started work in June 1986.

Among the changes called for by the Colwell committee was a doubling of funds to update the scientific programs in basic engineering, health, medicine, and the social sciences, and to drastically improve logistics—the movement of people and supplies to and from the regions. The case for a new ice-breaking research vessel, a new South Pole station, and other improvements was bolstered by an outside panel on Antarctic safety, headed by astronaut Russell Schweickardt. Colwell's committee also urged certain infrastructure improvements, such as a new South Pole station and a new ice-breaking research vessel. Today, all fifteen of the Board committee's recommendations have been implemented, resulting in increased American influence in international polar policymaking.

1989 NSFNet is subcontracted in plan for future spinoff of Internet to the public

1989 Communist rule in Eastern Europe crumbles; Berlin Wall falls

1989

NSB Chair Good
NSF Director Bloch